

# Stream Depletion Zones the hydrologic perspective



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## **Some ground rules...**

Stream Depletion results from pumping groundwater until the groundwater discharge to the stream is reduced and/or flow from the stream to groundwater is induced. Both conditions reduce stream discharge.

### **Stream Depletion is independent of stream discharge**

same effect whether 1000 cfs or 10 cfs

Unless, of course, you dry up the stream

### **Stream Depletion is independent of well interference**

it is both cumulative and additive

1 well pumping 500 gpm

has the same effect as

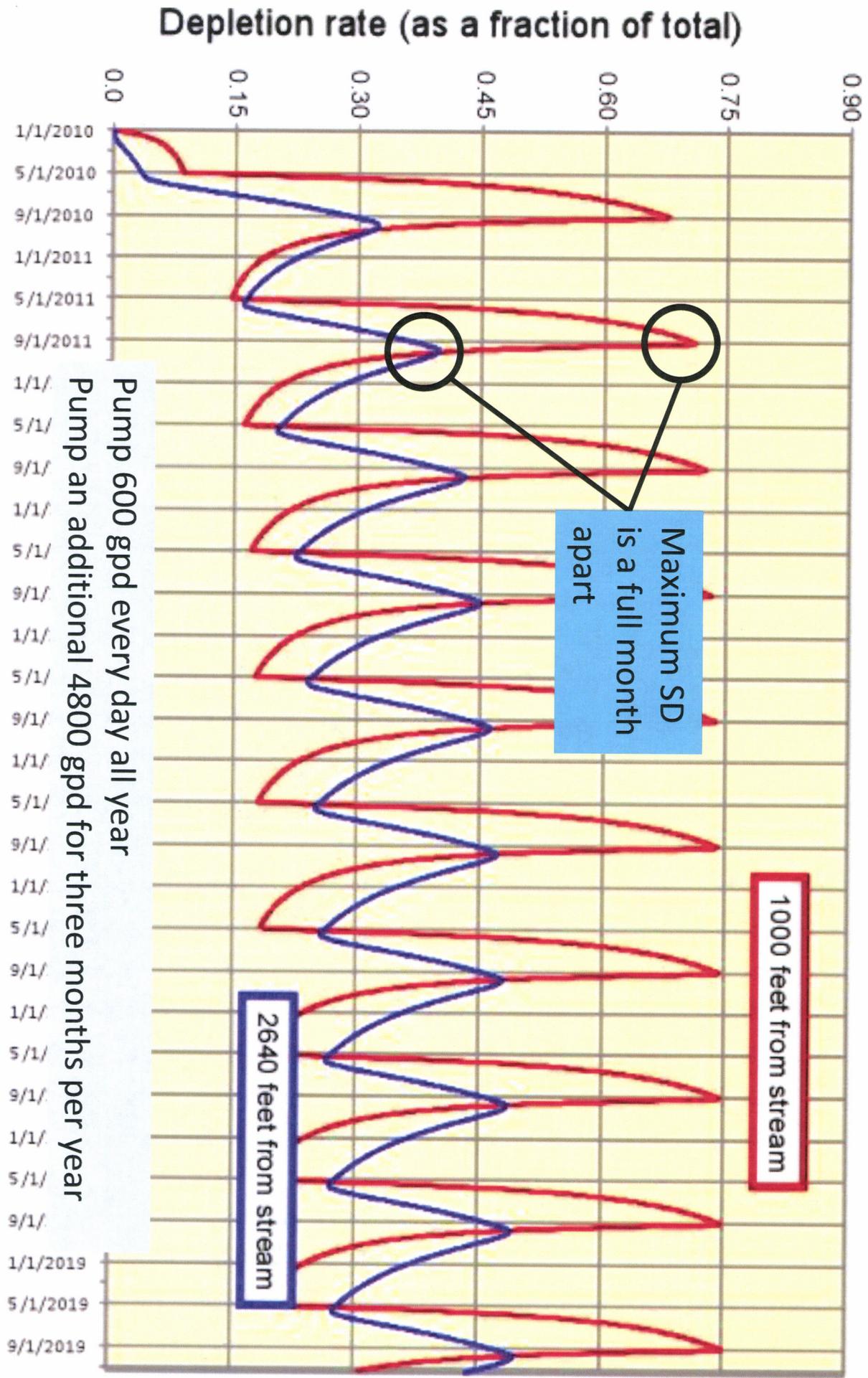
50 wells pumping 10 gpm

Depletion does not stop when pumping stops

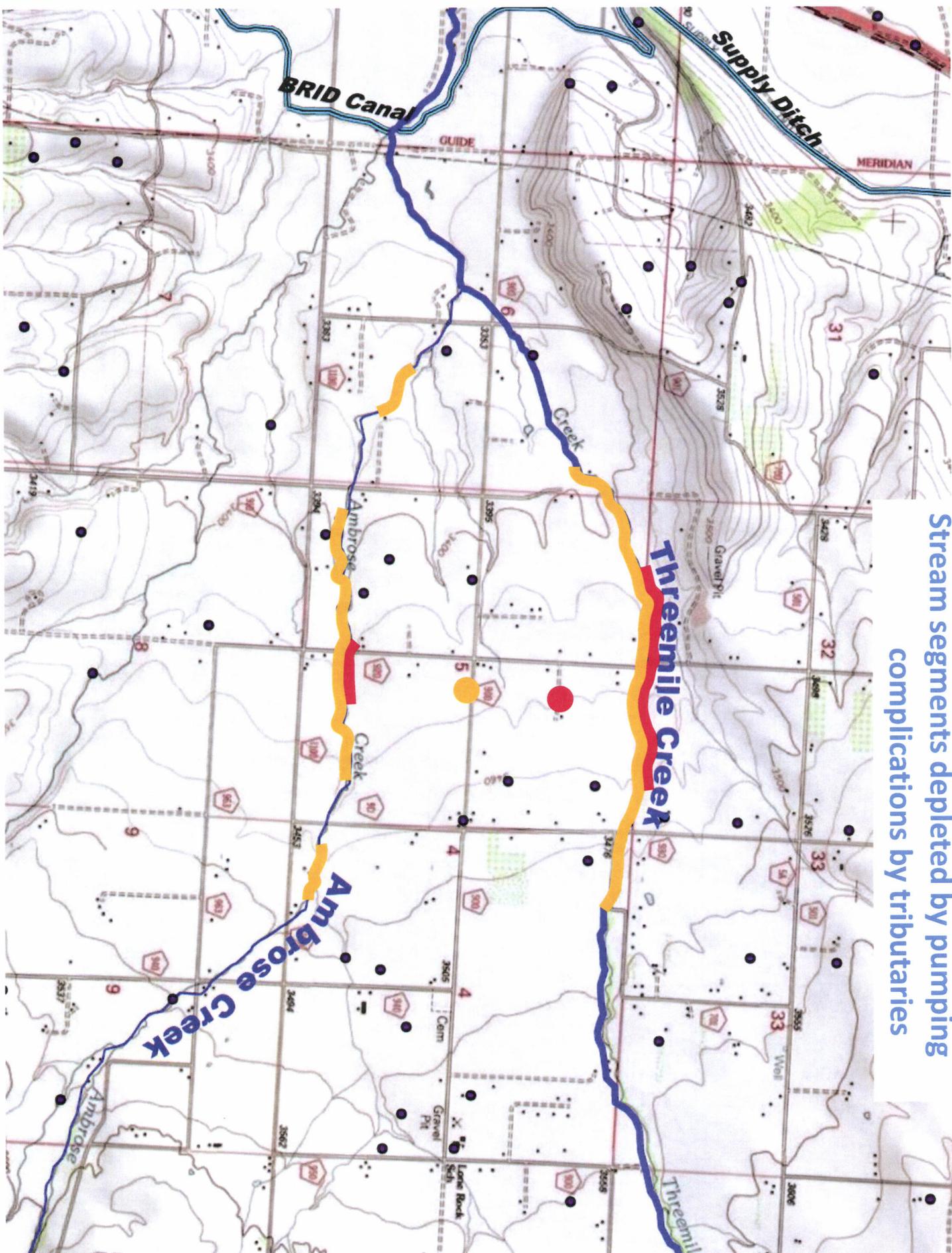
### **Stream Depletion is independent of distance from the well(s) to the stream**

*BUT the RATE of depletion IS dependent on distance*

Depletion rate versus distance from stream



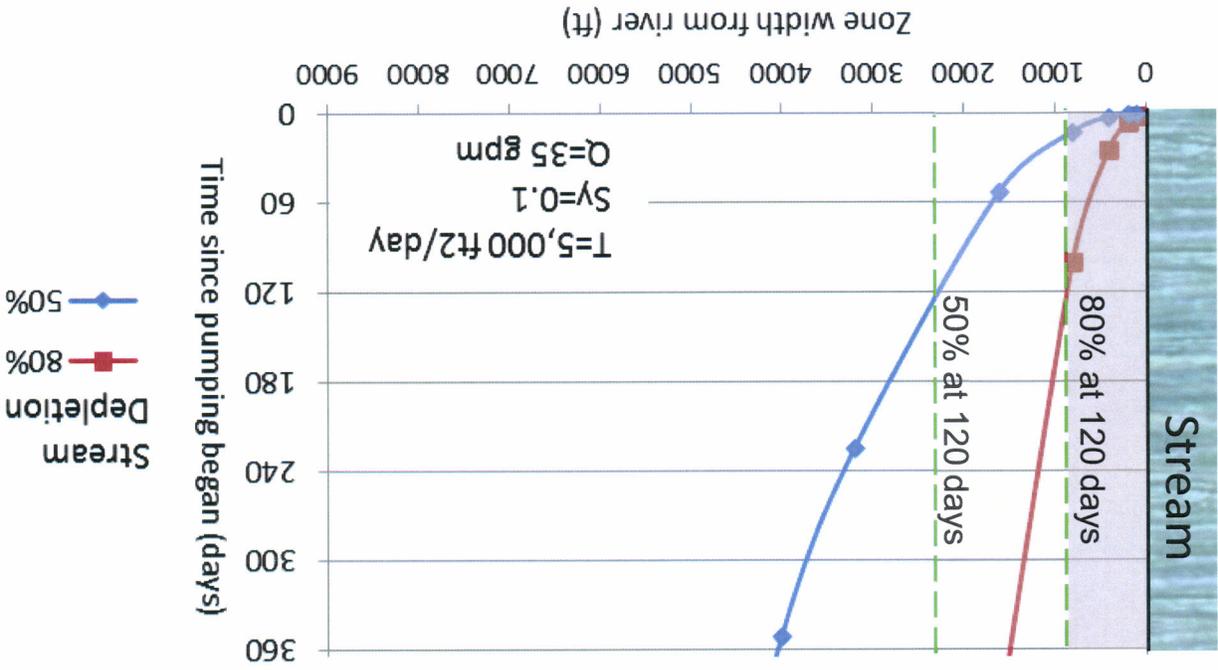
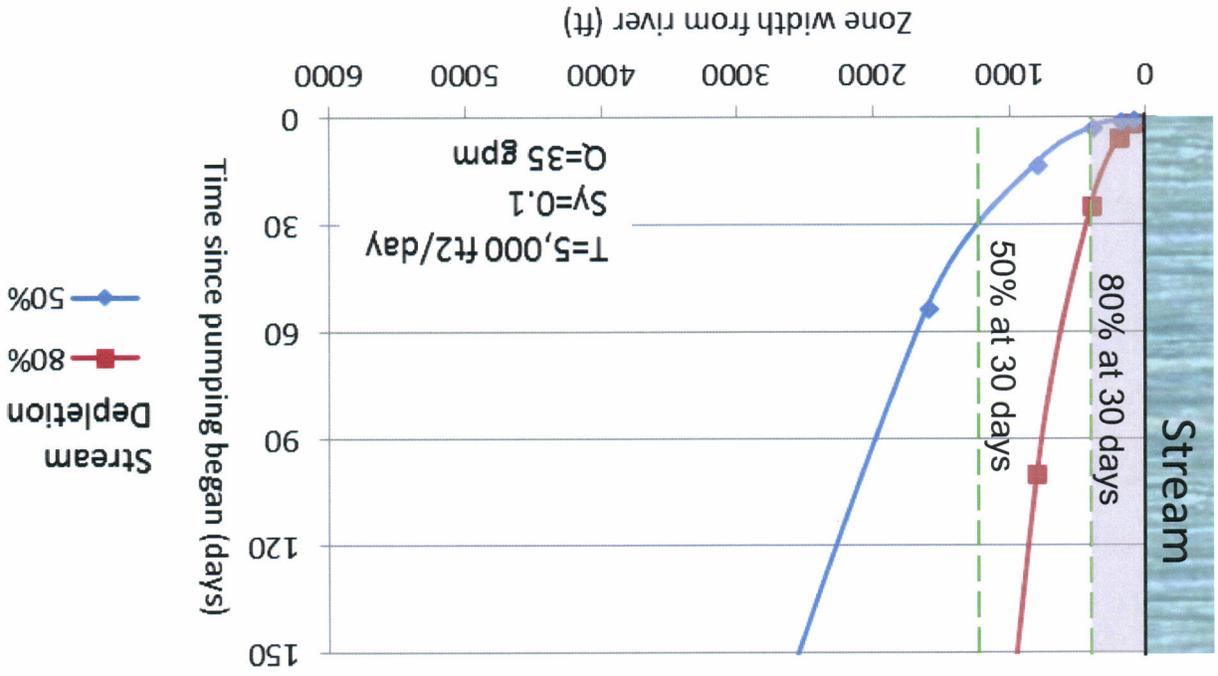
Stream segments depleted by pumping  
complications by tributaries



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### Moderately productive alluvial aquifer

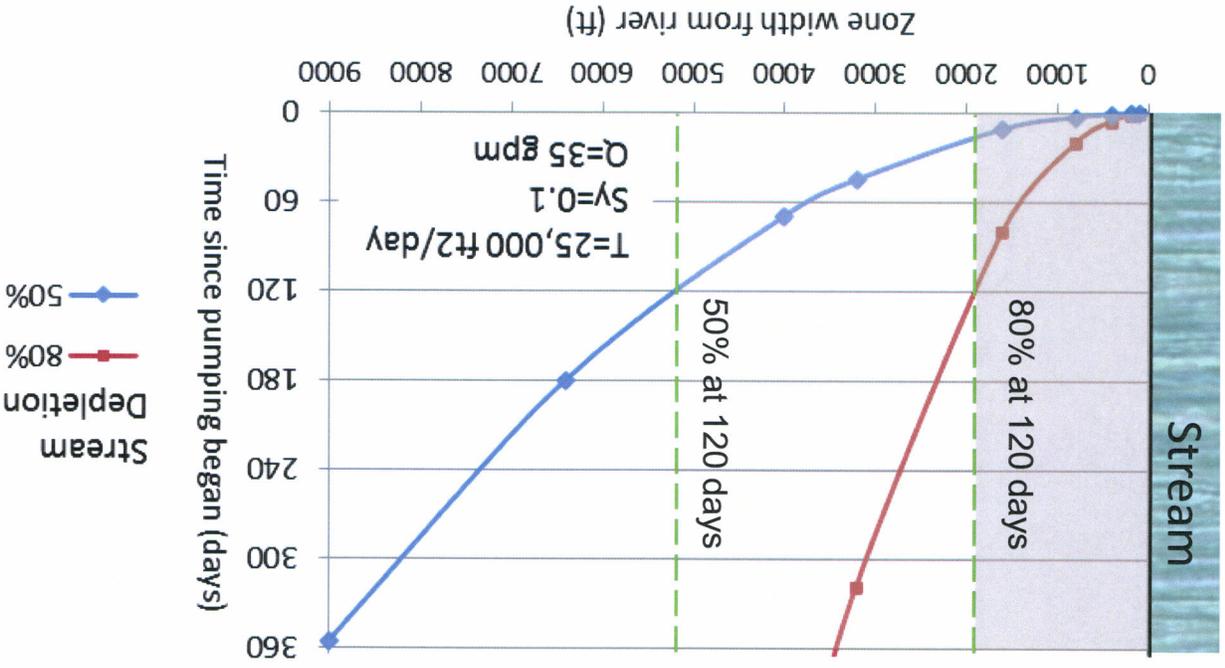
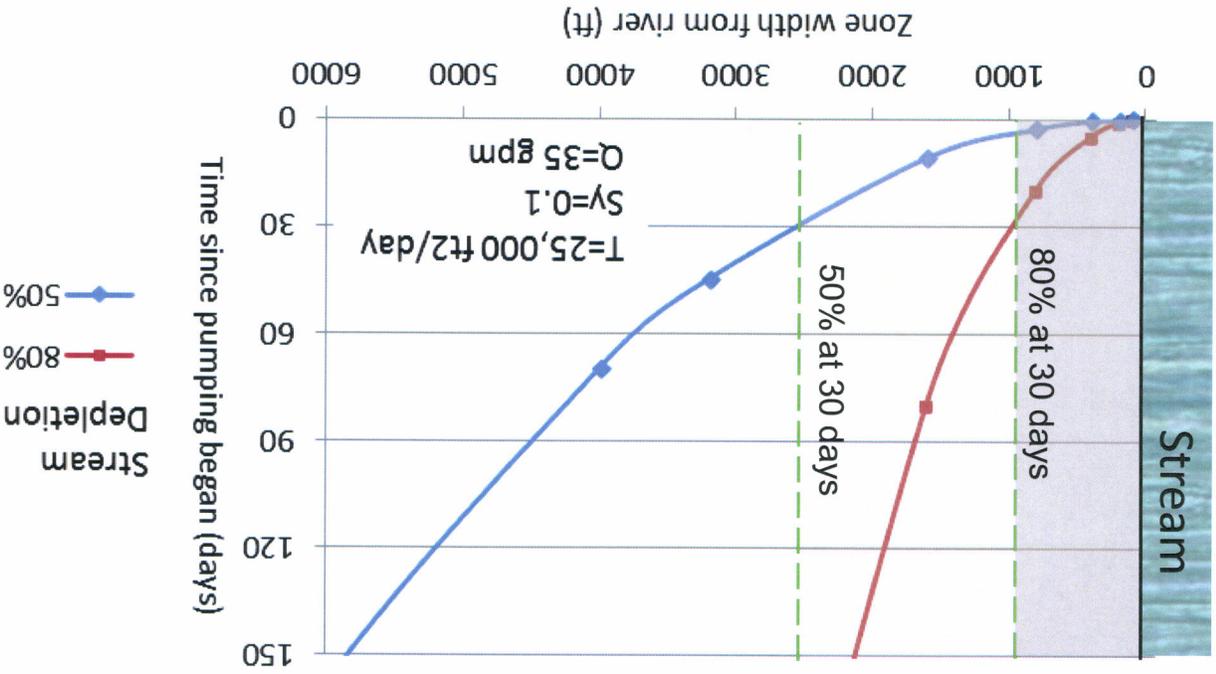
Transmissivity = 5,000 ft<sup>2</sup>/day



Textbook example based on the "Colorado Model" (WPM Software, 2001; based on Schroeder, 1987). See model documentation for assumptions and limitations.

## Highly productive alluvial aquifer

Transmissivity = 25,000 ft<sup>2</sup>/day



Textbook example based on the "Colorado Model" (WPM Software, 2001; based on Schroeder, 1987). See model documentation for assumptions and limitations.

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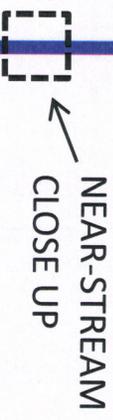
# "SANDBOX" MODFLOW MODEL

- Homogeneous
- Isotropic
- Semi-infinite aquifer
- Fully-penetrating stream

- ALLUVIAL GRAVEL PROPERTIES
- $T = 10,000 \text{ FT}^2/\text{DAY}$
  - $Sy = 0.1$

SDZ RESULTS MIRROR  
ANALYTICAL SOLUTION

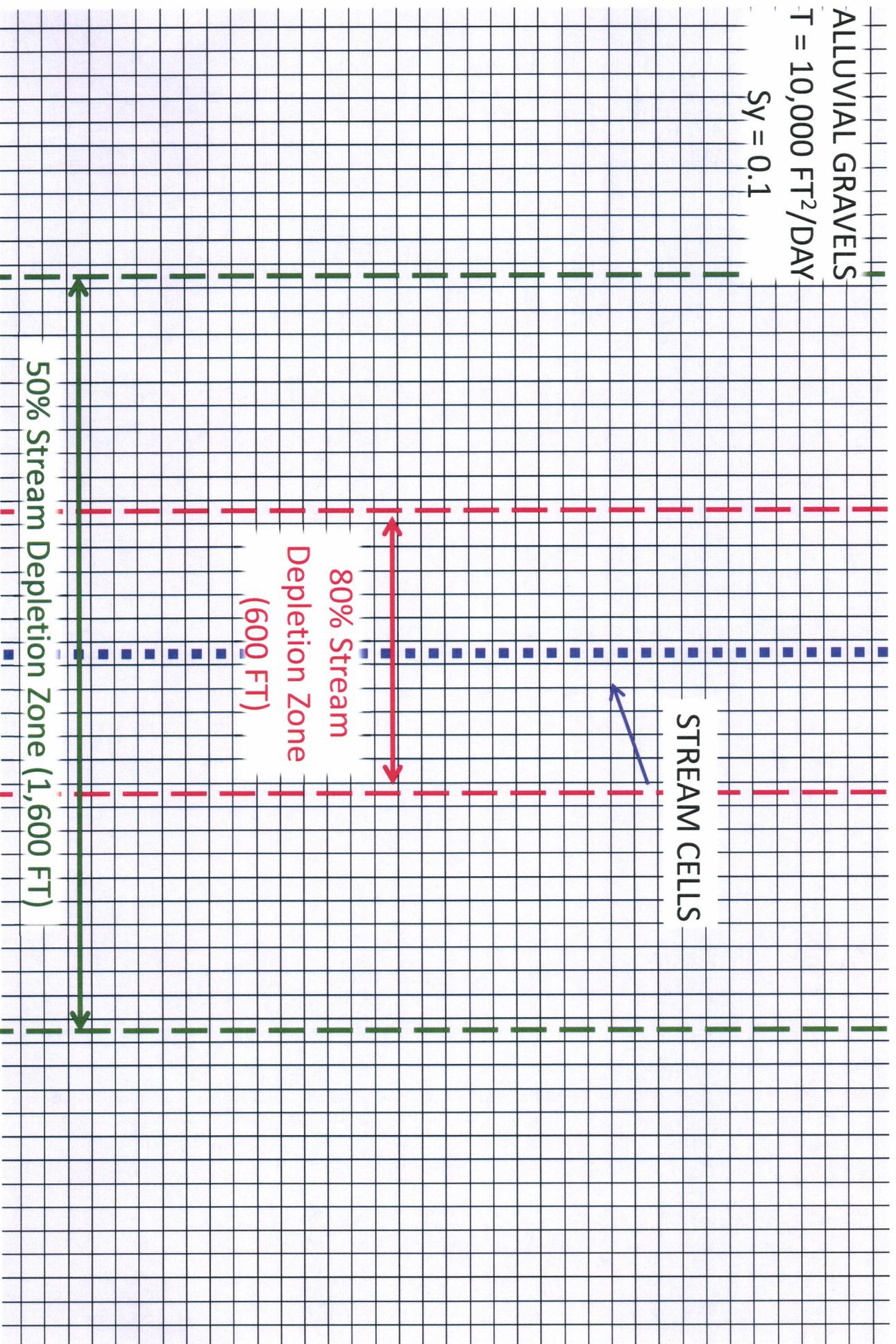
STREAM CELLS



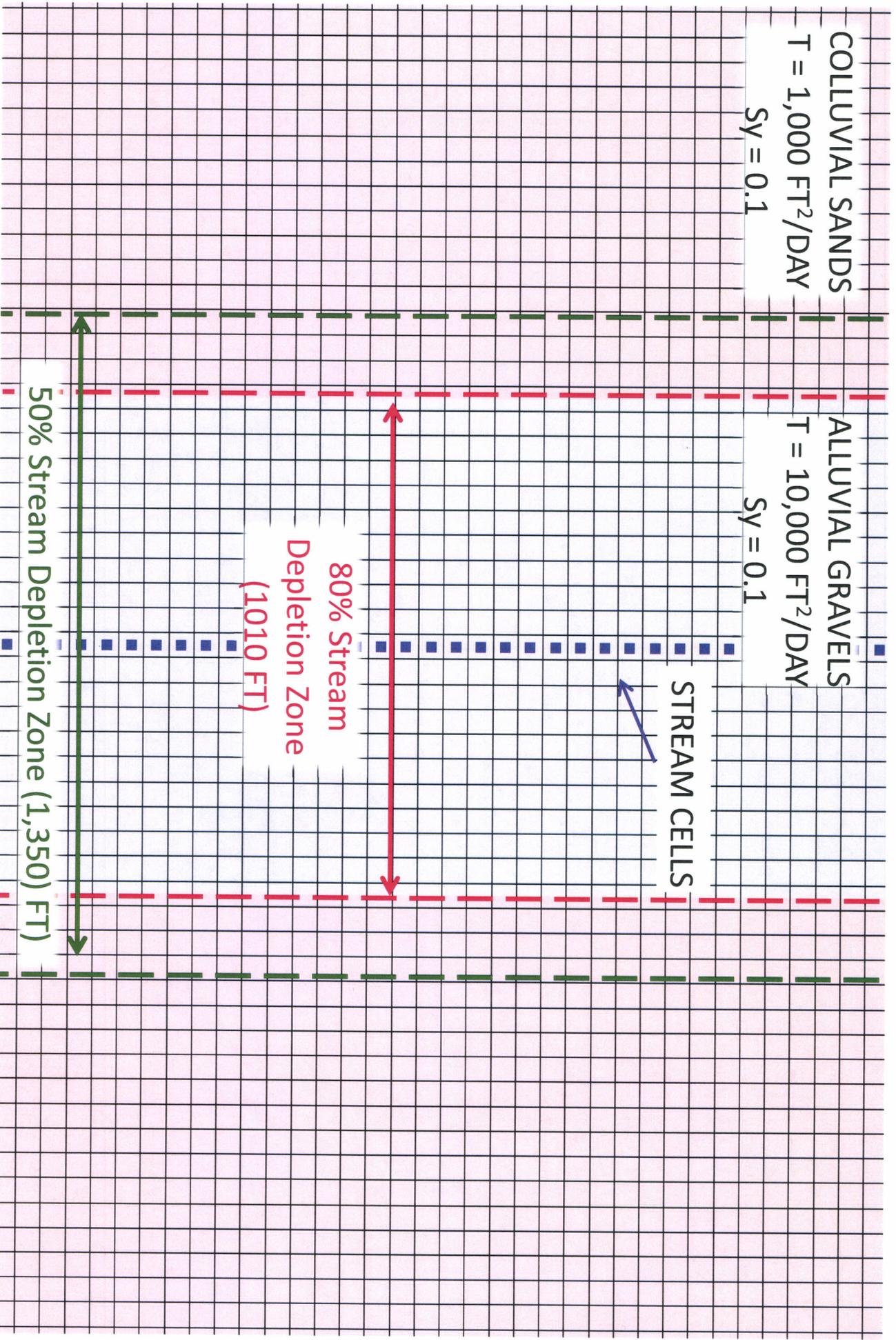
CONSTANT-  
HEAD CELLS

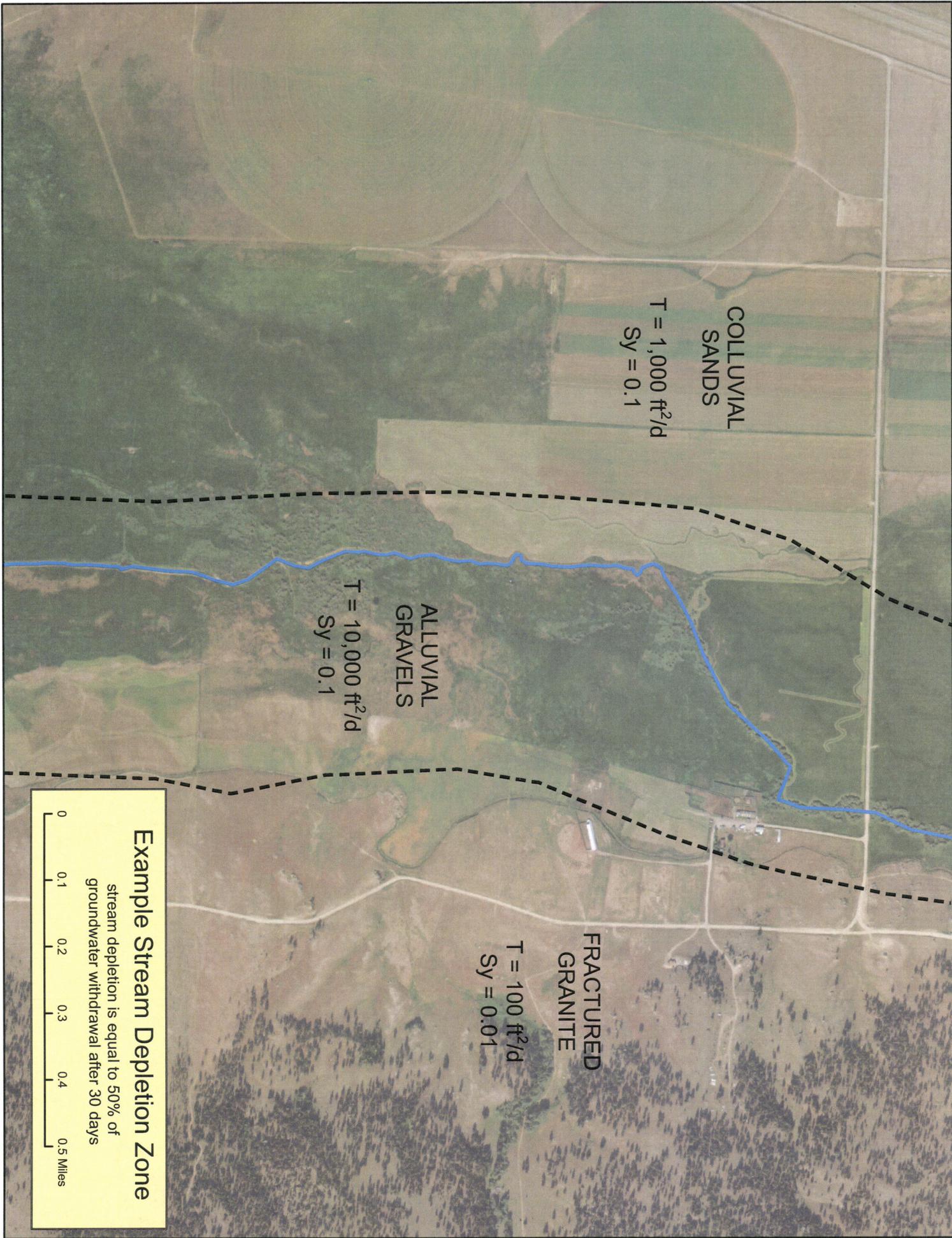
100,000 FEET

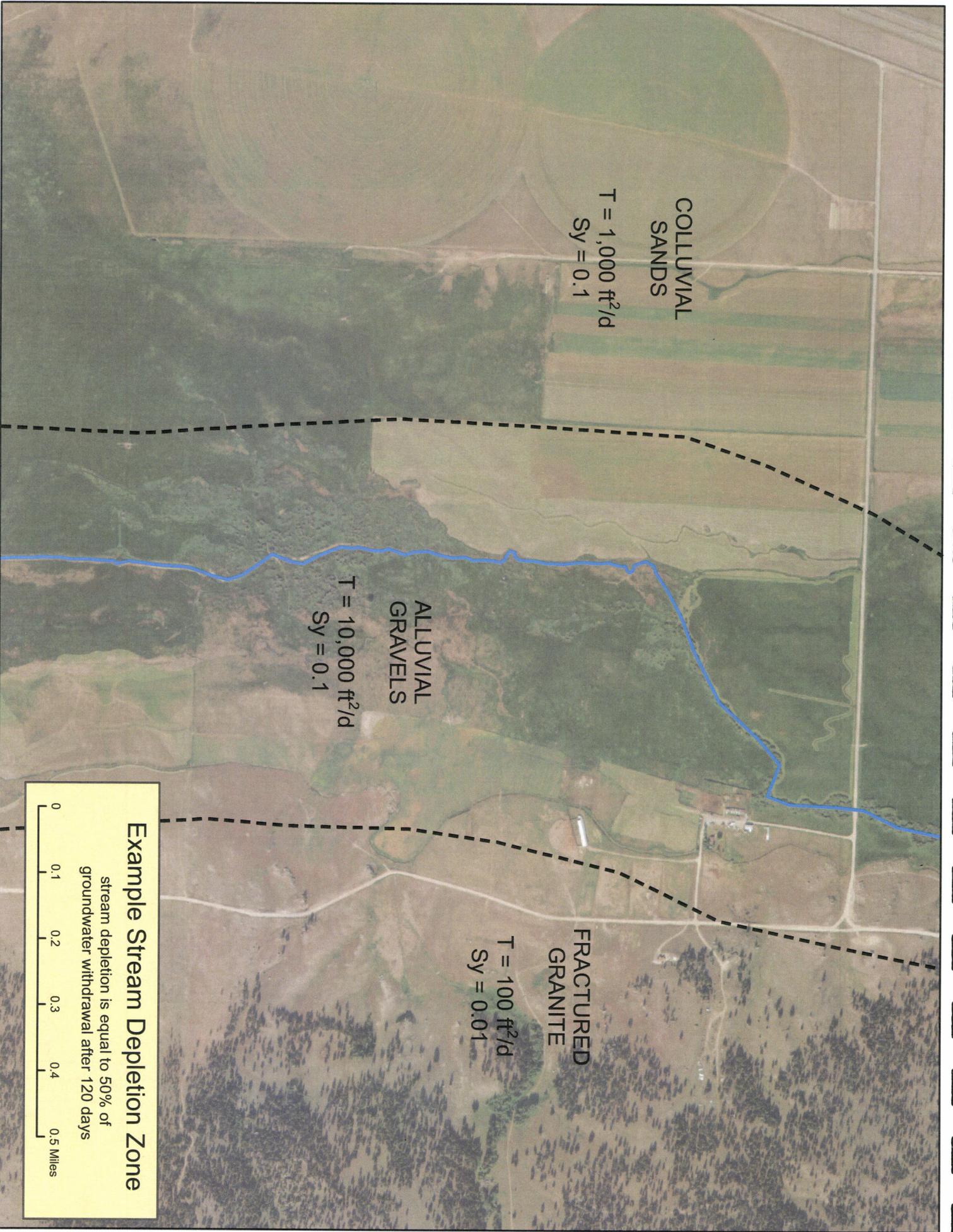
# STREAM DEPLETION ZONES AFTER 30 DAYS OF PUMPING AT 35 GPM IN A HOMOGENEOUS AQUIFER

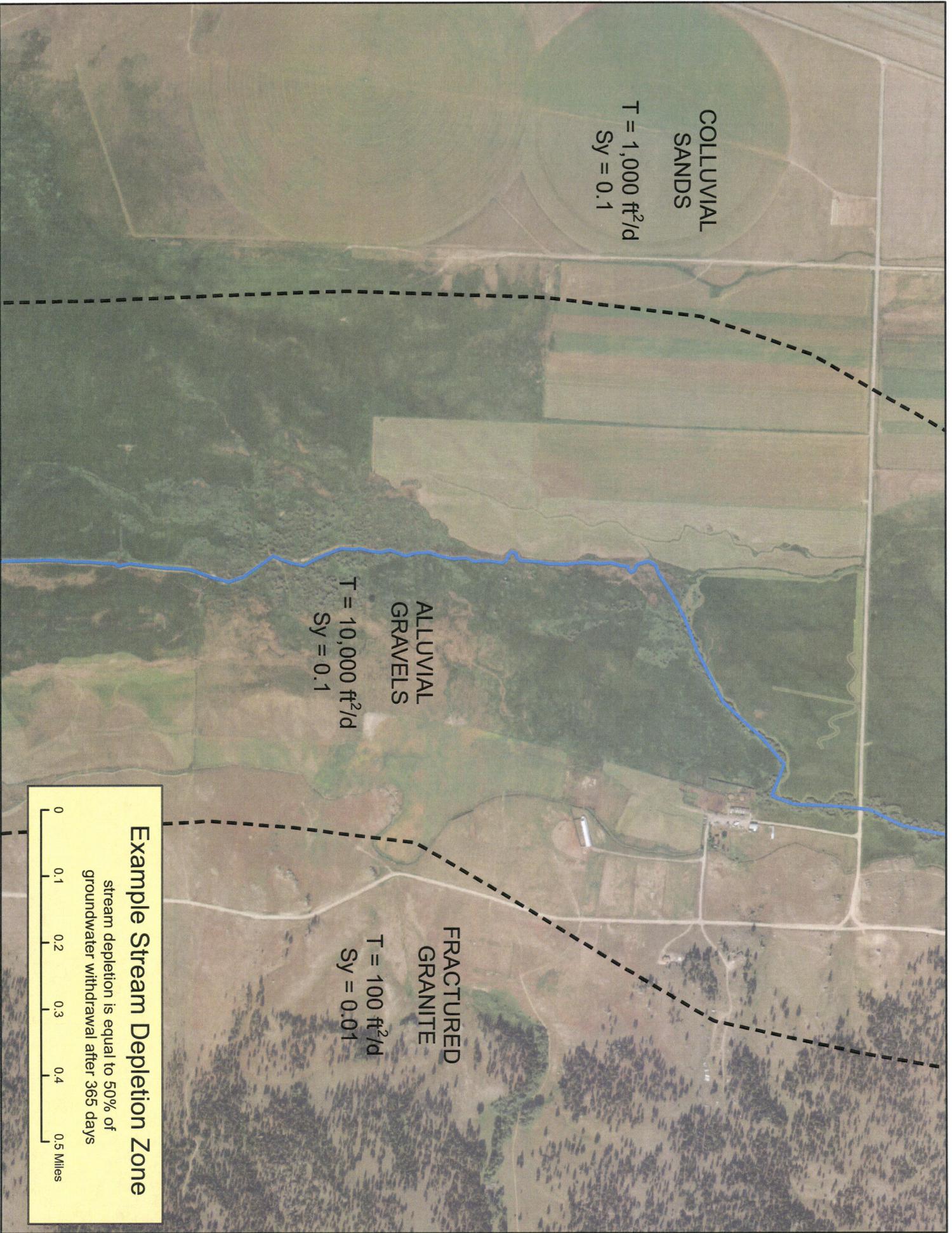


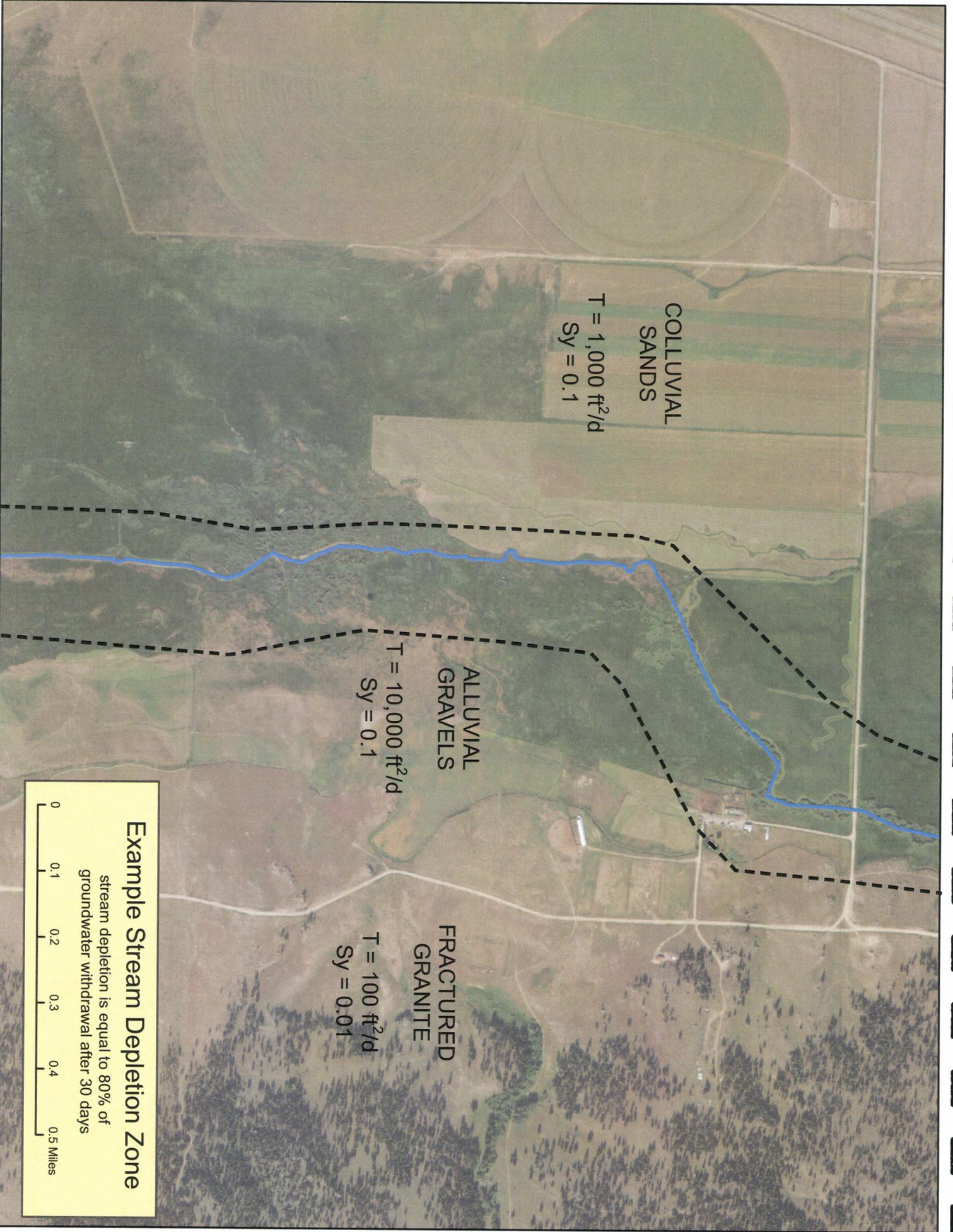
# STREAM DEPLETION ZONES AFTER 30 DAYS OF PUMPING AT 35 GPM IN A (SIMPLIFIED) HETEROGENEOUS AQUIFER

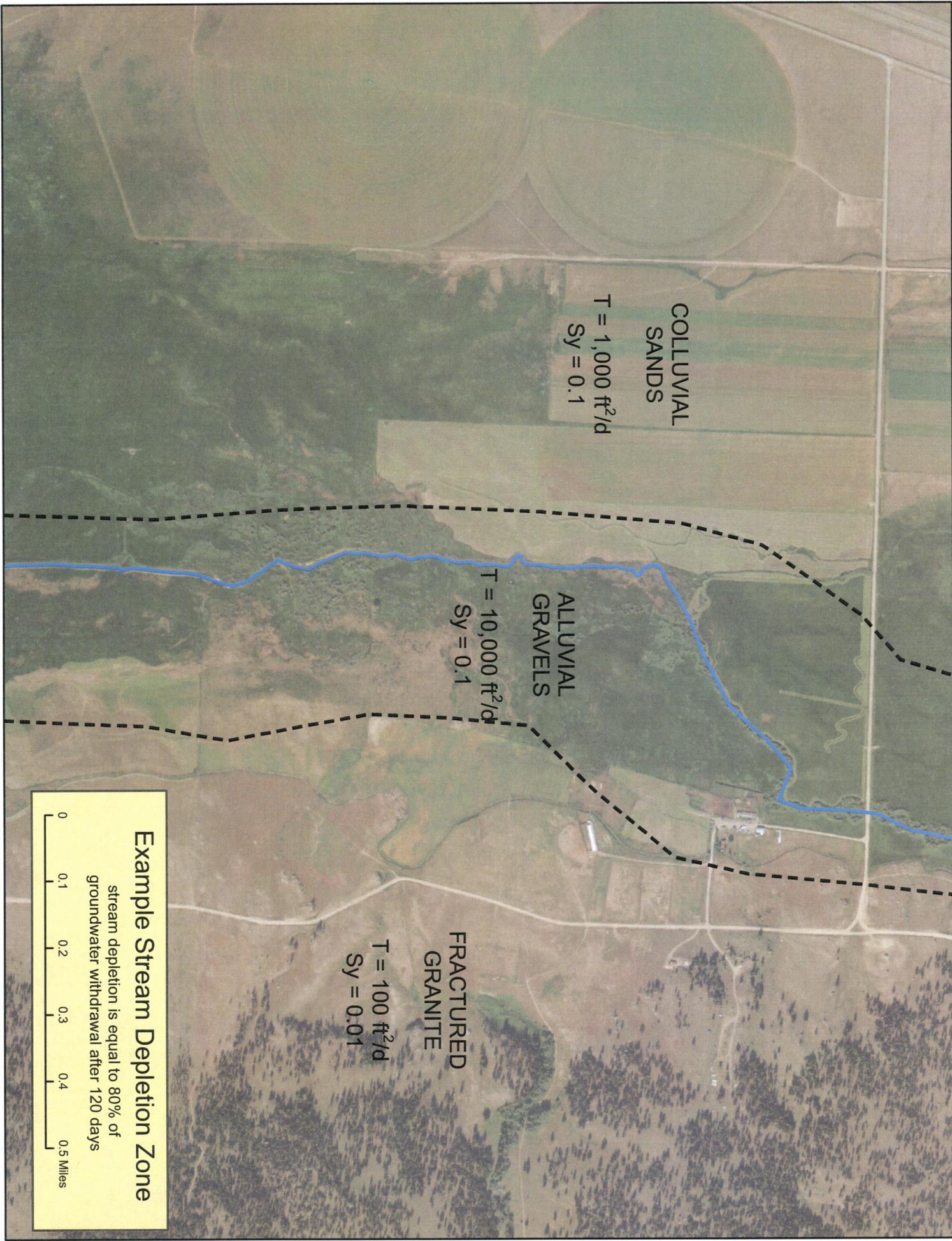


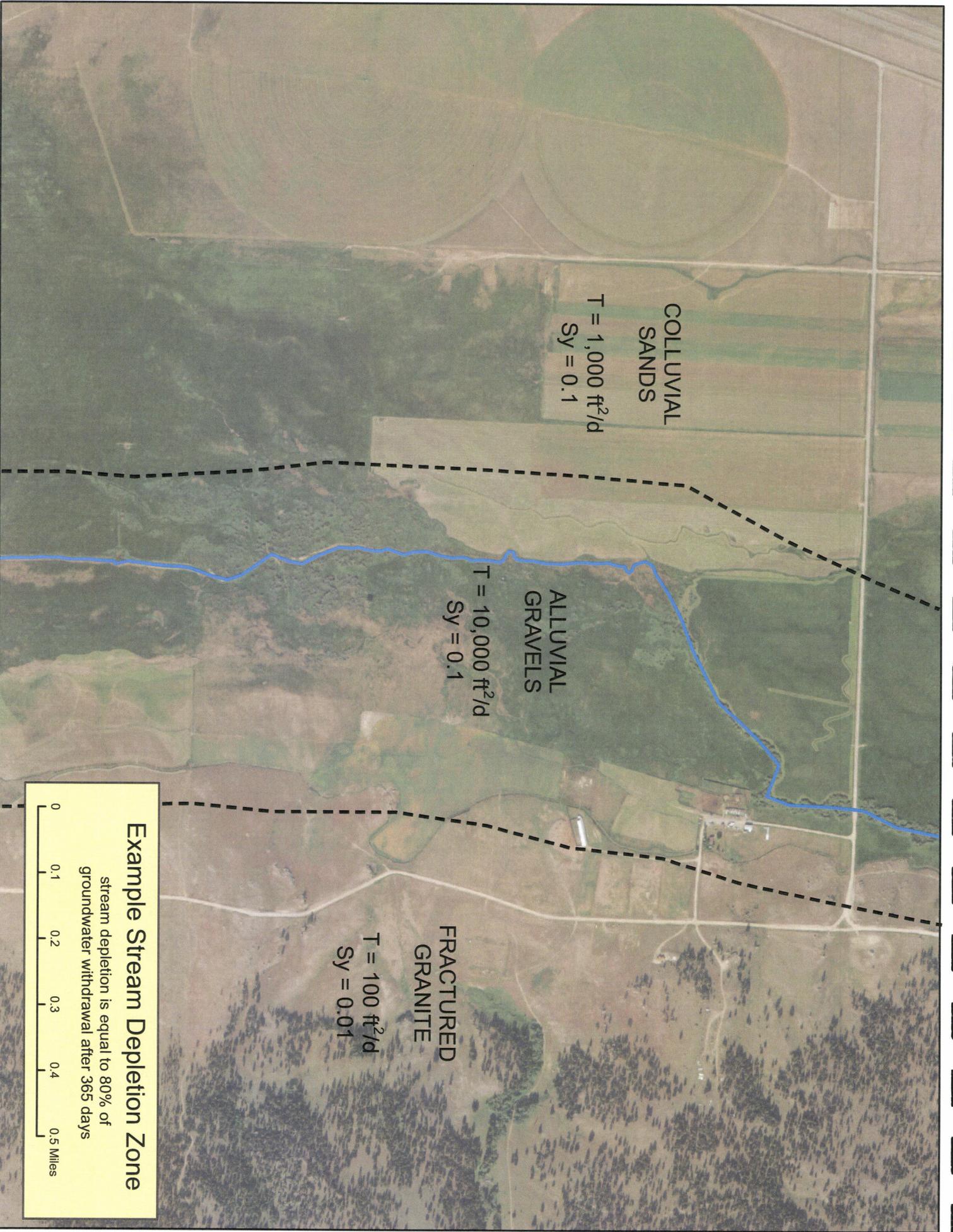












# Complications

- Some hydrogeologic conditions can be quite complicated: more data, more complex models may be needed.  
e.g. Eightmile Creek basin
- Multiple tributaries can result in overlapping zones
- Aquifer conditions can change dramatically with depth  
e.g. Flathead Lake basin, lower Beaverhead River basin
- Cumulative error in establishing zone line can be significant (but, can be defined)  
aquifer test data and analyses  
subsurface mapping of lithology  
model method